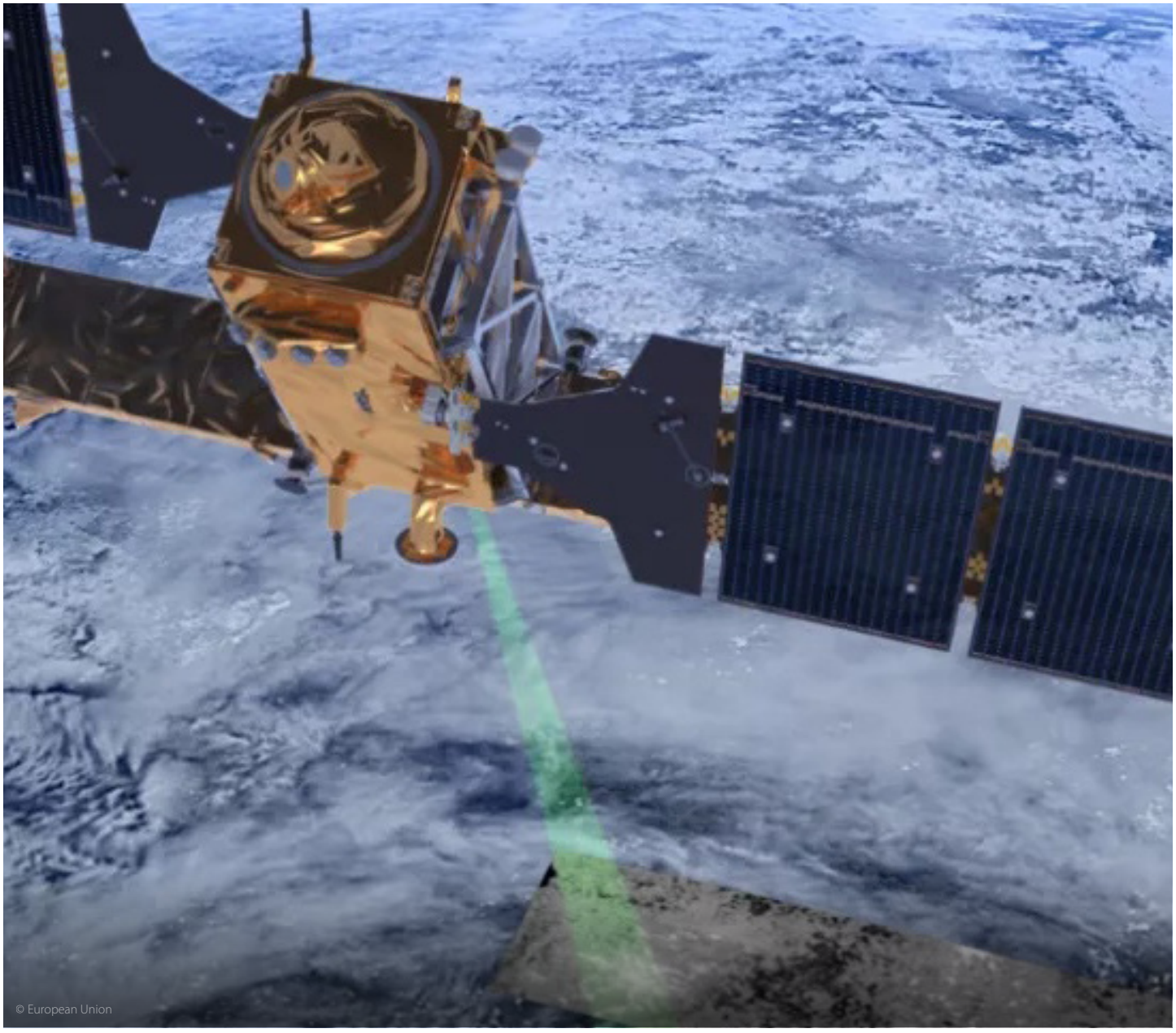
EUROPEAN STATISTICAL SYSTEM

Earth observation for statistics (EO4S)

Integration of earth observation data into statistical production processes



The project

Contributing to the European Statistical System (ESS) Innovation Agenda, the integration of earth observation data into statistical production processes (EO4S) aims to fulfil the ESS' objective to test and integrate novel earth observation (EO) data into the statistical production process.

As such, EO4S assesses relevant projects and EO data products, as well as statistical data needs and proposes topics of interest with respect to the statistical production process. For these topics, incubation and pilot projects aim at providing the necessary skills, EO, statistical and information technology requirements, and methodological frameworks towards statistical production from EO data products.

The motivation

The Warsaw Memorandum on Earth Observation, adopted at the 106th Directeurs Généraux des Instituts Nationaux Statistiques (DGINS) Conference in 2021, outlined the opportunities and the will of the ESS to test and integrate EO data into the statistical production process. This was reinforced by the recommendations of the 48th Meeting of the European Statistical System Committee (ESSC) in 2022.

Against this background, EO4S aims to make the integration of EO data into statistical production a reality for which several incubation projects in the most promising areas have been selected.

This innovation activity aims to address various challenges. Knowledge on EO in the ESS is heterogeneous among Member States, and mostly at an early development stage. Furthermore, although data sources are available, it is a challenge to deliver products according to statistical business requirements around quality assurance, business continuity and time series. The availability of pre-processed EO data must also be sustainable, and for validation reasons the availability of certain ground-truth data is crucial. The longer-term goal is to deliver methodologically harmonised and consistent ESS coverage on statistical data production, based on EO in statistical fields where this is feasible.

The methodology

The work started with assessing past and ongoing projects in the ESS and EO products. It includes analyses of necessary and available skills, and the definition of IT requirements and processes that are necessary to integrate EO data into statistical production.

The process from EO to statistics requires several intermediate steps, which are depicted in the following figure and table.

Figure 1. A simplified process diagram which shows the five main steps of deriving a statistical product from EO data.

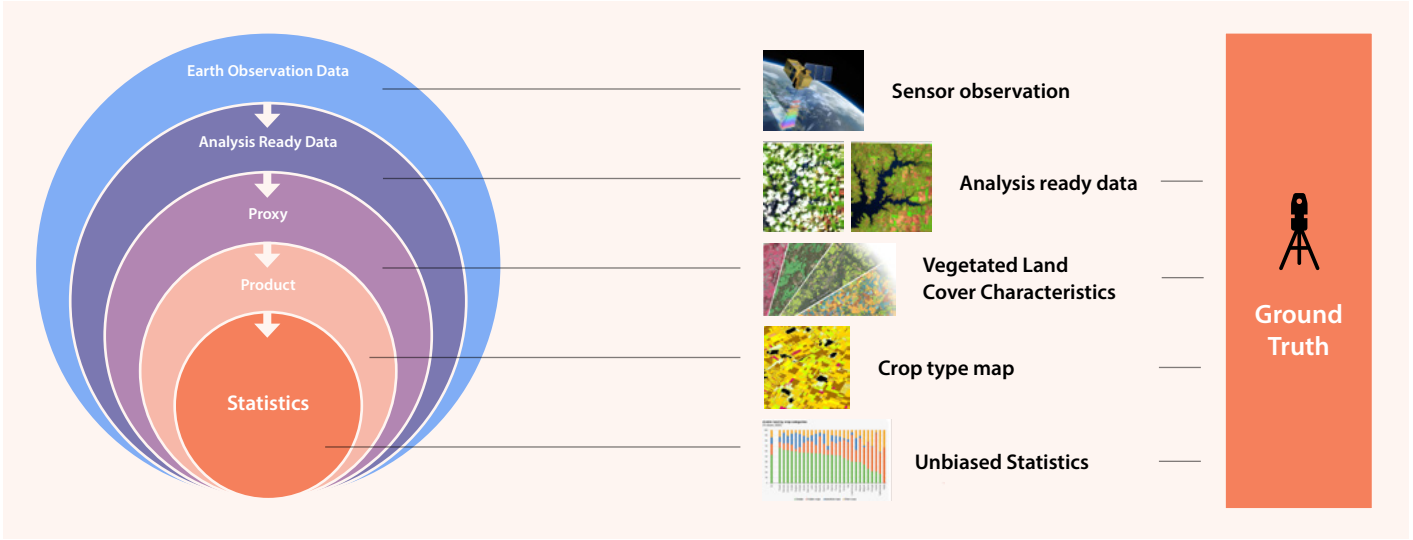
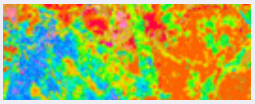
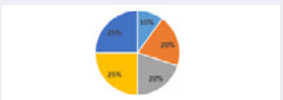


Table 1. Main steps of deriving a statistical product from raw EO data.

STEP	1	2	3	4
INPUT	Raw data (Satellite image)	Analysis Ready Data	Proxy	Derived product
OUTPUT	Analysis Ready Data	Proxy	Derived product	Statistics
What happens?	Clouds removed Orthorectification	Interprets Analysis Ready Data into a proxy	Conversion between a proxy and a product	Calculation of statistics
Who does it?	EO expert	EO expert Geospatial expert	EO expert Geospatial expert	Geospatial expert Statistician
Examples	Sentinel-2 Mosaic (Apr - Jun 2024)[1]	Phenology stage – End of Season date[2]	Crop type classification[3]	Statistics[4]
Visualization				
Colour of the image represents	Red, green and blue (RGB) ratio of satellite image	Calendar dates when leaf discolouration occurs	Different types of crops	% of different types of crops

Through setting up and implementing specific use cases, EO4S traces the respective steps, then assesses the quality of the statistics produced. As validation of the methodology, each use case finishes with comparing statistics resulting from EO and data from current statistical production processes. In each use case, there is a possibility of EO complementing (e.g. spatial or temporal dimension), validating or replacing traditional statistics. The activities also seek to document the methodology, the products, and the process and perform quality assurance of the new statistical processes. EO4S intends to create standard procedures that can be documented and reproduced at European, national or regional levels.

In summary, the activities are based on implementing the recommendations and actions of the 48th meeting of the ESSC, which include:

- assessing progress and experiences within the National Statistical Institutes;
- identifying possible candidate domains as test fields;
- drafting the requirements (consulting ESS delegates and Eurostat thematic units) for possible implementation and upscaling of proof of concepts;
- setting up an IT platform for the processing of EU-wide EO data (Copernicus Data Space Ecosystem (CDSE));
- testing various domain-specific applications.
- Regular task force meetings are organised to communicate and exchange on technical aspects.

Technologies and methodologies involved: Geographic information systems and geo-datasets, geospatial tools and services including EO, CDSE (sentinel data), artificial intelligence, machine learning, big data, unbiased statistics.

The team

Involved stakeholders:

- **Member States**: All Member States involved have been consulted through the Earth Observation Task Force, which is linked to the ESS Working Group (WG) on the Integration of Statistical and Geospatial Data (WG GISCO). The Task Force includes National Statistical Institutes and National Mapping Cadastral Agencies.
- **European Commission**: Potential links to the Copernicus services and involved Directorate-Generals (DG), e.g. the Joint Research Centre (including Knowledge Centre for EO), DEFIS and the European Environment Agency, and links to thematic DGs with interest (e.g. DG AGRI) and ESTAT Units.
- **External partners / researchers involved**: European Space Agency, National Space Agencies, the Organisation for Economic Co-operation and Development (OECD), Food and Agriculture Organization of the UN (FAO) and other researchers with EO projects.

Contact: ESTAT-GISCO-EO@ec.europa.eu

The timeline

- **Initiation:** 2023
- **Estimated time to deliver impact:** 2026

More information

- CROS page: https://cros.ec.europa.eu/group/earth-observation-statistics-eo4s/about

1 Copernicus Browser.
2 Copernicus CLMS: Bio-geophysical parameters / vegetation / end of season date.
3 https://www.nature.com/articles/s41597-024-03884-y (Image is only illustrative)
4 Including metadata (methodology, accuracy).